

AMATEUR SATELLITE REPORT

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JARL/JAMSAT Announce JAS-1 Specifications

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with Harold Price, NK6K

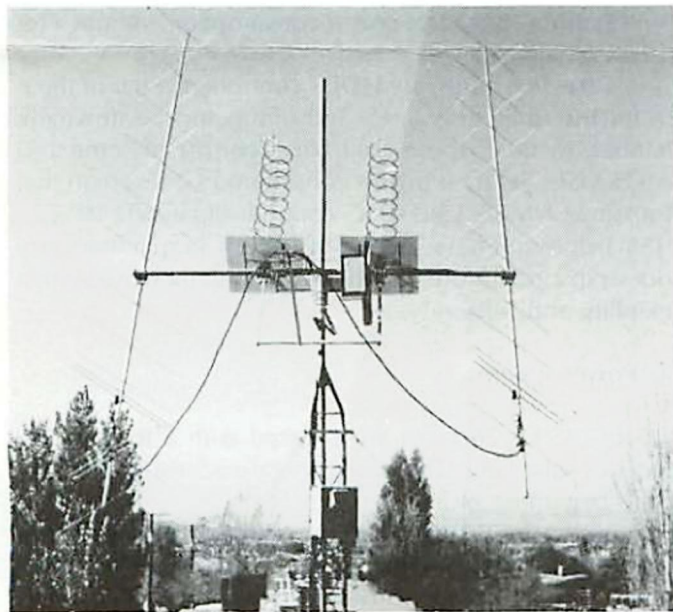
JAS-1 is an Amateur Radio satellite, promoted by JARL as a joint venture with NASDA* NEC** constructed "system" units (space frame, power supply etc.), while JAMSAT, with its selected volunteer JAS-1 project team, designed and built the "mission" units (transponders, telemetry/command and house keeping micro-computer) and ground support systems.

JAS-1 has been completed and has passed all the necessary tests. It is in a clean room waiting for the launch, currently scheduled for August 1986.

The general specifications of this unique satellite are detailed below. Many thanks to Harold Price, NK6K, for his assistance in the preparation of this article.

JAS-1 Mission Objectives:

A. JAS-1 will provide reliable world-wide Amateur Radio communications.



This fb array performs for Mel Pfeffer, W5LTR, of Albuquerque, NM. The array features dual homebrew 70 cm helices.

B. JAS-1 will enable Radio Amateurs to study tracking and command techniques.

C. JAS-1 will offer an in-space "proving ground" for Radio Amateur developed and built transponders and sub-systems.

D. JAS-1 will provide NASDA an opportunity to carry out a "multi-payload" launch using their new "H-1" launcher. (NASDA has never engaged in a multi-payload launch, thus the JAS-1 project will offer NASDA an excellent opportunity by providing them with an active payload having its own telemetry-beacon and transponder for ranging.)

1. Form and general dimensions:

The spacecraft takes the form of a 26-facet polyhedron, which measures 400 mm X 400 mm X 470 mm and weighs 50 kilograms.

2. Launch and Orbit:

JAS-1 will be launched into a circular low-earth orbit, which will be non-sun synchronous and non-polar.

Launch vehicle: H-1 2 stage rocket
Launch number: Test Flight # 1
Launch site: Tanegashima Is. Japan
Launch date: August 1986
Estimated inclination: 50 degrees
Estimated altitude: 1500 k.m.
Estimated period: 120 minutes
Estimated window per pass: 20 minutes/pass
Estimated passes per day: 8 passes/day

3. Designed life: Estimated lifetime is 3 years

4. Special Features of JAS-1:

JAS-1 carries two separate Mode J transponders. One is a linear transponder and the other is a digital "store-and-forward" transponder mainly for non-real-time communication between stations located in different time zones.

The reasons for selecting Mode J for this first Japanese Amateur Radio communications satellite are:

*NASDA: The Japanese National Space Agency

**NEC: Nippon Electric Corp.

a) It is becoming increasingly difficult to use 145-MHz for a satellite downlink because of man-made electrical noise and other interference.

b) The planners of JAS-1 wanted to provide a successor to AMSAT OSCAR-8's Mode J, which was originally developed by JAMSAT's engineering team in 1976.

c) 435 MHz is much quieter than 145 MHz as a downlink band, it is comparatively free from man-made noise and sky-temperature effects.

The digital transponder will provide "error-free" information exchange.

5. Transponders:

a) The linear transponder = Mode JA:

The passband will be 100 kHz wide. The transponder will have an output of 1 watt pep. Ground stations will need an uplink power of 100 watts eirp. The sidebands will be reversed, i.e., the uplink is LSB, the downlink is USB. There will be a 100 mW CW beacon switchable to PSK when needed.

Uplink pass band: 145.90 MHz - 146.00 MHz
Downlink pass band: 435.80 MHz - 435.90 MHz
Beacon freq.: 435.795 MHz
Translate freq.: 581.80 MHz

b) The digital transponder = Mode JD:

There will be four 145 MHz band input channels using *Manchester coded FM* for the uplink. Ground stations will need 100 watts eirp. There will be one downlink channel in the 435 MHz band using PSK, the output will be 1 watt RMS.

Channels are:

Uplink channel 1: 145.850 MHz
Uplink channel 2: 145.870 MHz
Uplink channel 3: 145.890 MHz
Uplink channel 4: 145.910 MHz
Downlink channel: 435.910 MHz

The data format is HDLC. The protocol is AX.25 Level 2 Version 2. The data transfer rate is 1200 bps for both uplink and downlink.

The reasons for not using Bell-202 type FSK modulation are:

a) To reduce the parts count onboard JAS-1. Using Manchester coded FM for uplink reduces JAS-1's onboard decoder chip count by 16.

b) To improve the downlink margins. Due to JAS-1's tight power budget, only 1 watt is generated by the downlink transmitter. A more efficient modulation scheme like PSK is required.

JAS-1 will be a store and forward system but not a real time digipeater. Digipeating is not an effective use of a low orbit satellite such as JAS-1, which has a limited communication foot print and visibility time.

JAS-1 has 4 uplink channels for 1 downlink channel. This is because of the difference in channel efficiency between uplink and downlink. An uplink channel is shared by several ground users. Since the ground users can't hear each other, and are listening to the downlink channel anyway, the uplinks are subject to packet collisions. This scheme is called "Pure ALOHA", and is known to have a theoretical maximum channel throughput of 18.4%. The JAS-1 downlink is 100% efficient, since only JAS-1 transmits there. To balance capacity, as well as add redundancy, four uplink channels are used.

The combined uplink efficiency is then $4 \times 18.4\%$ or 76%. The remaining downlink time is used for general messages and telemetry data.

JAS-1 will accept a connect from only one station at a time with the software scheduled for initial use. Multiple connections will be supported in subsequent software updates. General packet operation is scheduled to begin in November 1986.

6. Digital Hardware:

The microprocessor is a MIL-STD-883B screened NSC-800 running with a 1.6MHz clock. This is the only processor on board. It controls the digital transponder and also acts as an IHU (Integrated Housekeeping Unit).

The on-board memory has a 1.5MB physical storage capacity. 48 chips of NMOS 256K DRAMs are used. A hardware based error-detection/correction circuit is incorporated to protect the entire 1.5 MB and provide an 1 MB error free memory area. The system program occupies some 32KB, the rest is used for message storage.

The memory unit is physically divided into four identical 256KB memory cards, any one of which can be assigned as the system area. Up to three cards can be turned off. This design provides system redundancy and allows command stations to control power consumption without a total loss of service.

JAS-1 has five hardware HDLC controllers. Four of them are for the uplink channels and one is for the downlink channel. In total, these controllers consist of some 140 CMOS MSIs, yet their power consumption is less than that of a single NMOS LSI HDLC controller like WD-1933.

JAS-1 does not have any ROM but has simple hardware boot strap circuit instead. This design is to increase system flexibility and reliability.

7. Power system:

25 of JAS-1's 26 faces are covered with a total of 979 pieces of solar cells. They will generate 8.5 watts of power at the beginning of life.

JAS-1 employs 11 Ni-Cd battery cells with a capacity of 6 AH. These supply 14 volts average to JAS-1's main power buss. The 14 volts is converted and regulated to +10V, +5V and -5V.

8. Antenna system:

JAS-1 has three antennas.

2 m reception antenna

Slant 1/4 wave Mono-pole Isotropic -4 dBi gain

70 cm transmission antenna

Mode-JA: Slant Turnstile LHCP + Z axis +3 dBi gain

Mode-JD: Slant Turnstile RHCP - Z axis +3 dBi gain

9. Attitude control:

Forced shaking using the earth's geomagnetic field. JAS-1 has two 1 ATm sq. permanent magnets in its Z axis.

10. Telemetry:

Analog system telemetry has 12 analog channels and 33 system status flags. This telemetry can be sent without the help of the NSC800 microprocessor and will be turned on automatically by the separation from the H-1 launcher. The telemetry is sent on the 100mW beacon on 435.795MHz in CW, switchable to PSK.

Digital system telemetry has 29 analog channels and 33 system status flags. This software driven telemetry can be sent in any format and can include short text messages. This telemetry can be sent on either the Mode JD downlink channel (435.910MHz) or the Mode JA CW beacon (435.795MHz).

11. Command:

A simple 3-channel tele-command system is used for global control functions, e.g. JA transponder "ON"/"OFF", JD transponder "ON"/"OFF" and independent "ON"/"OFF" of the A-0 beacon. An additional 37 channels are available mainly for controlling the digital transponder.

Onboard command from the NSC-800 is also available.

12. Ground stations:

Mode-JA:

A ground station setup which was used for AMSAT OSCAR-8 Mode-J can be used for JAS-1 Mode-JA. A station with a 10 watt 2 m SSB transmitter and a 10 dBi beam for uplink; and a 70 cm receiver (with low NF) with a 15 dBi beam for downlink; should be adequate for this job.

Mode-JD:

In addition to the Mode-JA set up, FM Mode is required for the 2 m transmitter.

Since JAS-1 uses the standard AX.25 protocol and 1200 bps data rate, ground stations will be able to use a TAPR-style TNC, a 2 m FM transmitter and a 70 cm receiver without modification.

The JAS-1 modem, a special interface board, will be made available containing the Manchester modulator and an audio PSK demodulator allowing connection to the "modem disconnect" connector of a TAPR-style TNC. The modem

also connects to the audio input and PTT of the 2m FM transmitter and to the audio output and frequency control (option) of a 70 cm SSB receiver.

Although JAS-1 will be available to individual access, the general Amateur community will benefit from "JAS-1 gateways". Messages relayed through gateways can be sent worldwide and is as easy as sending messages to distant stations via a WØRLI HF gateway.

Project OSCAR Meets, Elects New Officers

The 1986 Project OSCAR, Incorporated Annual Meeting was held at Foothill College in Los Altos Hills, California on 22 February. Forty-eight members attended.

The business meeting consisted of reports by the Secretary and Treasurer and a membership discussion of worldwide progress in Amateur satellite planning, engineering, and operations. Election of officers was conducted by the Board of Directors. Results were as follows:

Board Chairman; John Pronko, W6XN

President; Jim Eagleson, WB6JNN

Secretary; Nick Marshall, W6OLO

Treasurer; Gil Morris, WB6KCJ

President Eagleson concluded the meeting by making the following appointments:

Technical Director; Paul Shuch, N6TX

User Support Director; Ross Forbes, WB6GFJ

Accident Claims AMSAT Leader HB9OP

AMSAT has learned of the untimely death of one of its long-time members and active leaders. Theodore R. Vogel, HB9OP, was killed when struck by an automobile early February in the village of Founex, Canton of Vaud, Switzerland. Ted had been an AMSAT member since April 1973 and was LM-537. He had served as AMSAT National Coordinator for Switzerland for more than 10 years. He was also active in Ten-Ten International. He is survived by his wife, Simone. AMSAT extends its deepest sympathy to his family and shares the sense of loss of the Amateur Radio community.

Publications Overhaul Project Seeking Help

Several important planning milestones in the overhaul of AMSAT's publications interests have been passed recently. The recently mailed AMSAT *Satellite Journal* #7 has been well-received. And, according to AMSAT officials, future AMSAT publications will build on the foundations of the best of *Satellite Journal*, *Amateur Satellite Report* and *ORBIT Magazine* to provide a timely, responsive news and information service.

A key element of the publications overhaul is an improved access to the pages of ASJ and ASR by AMSAT members. A special effort is being mounted, therefore, to both invite

and coach first-time writers and would-be authors to participate in the new AMSAT publications plan. A "First Time Author's Guide" will be available at AMSAT HQ shortly to help the would-be author avoid some of the pitfalls which may have led to a disappointing response to a prior effort.

Moreover, AMSAT's editors will be making a special effort to help the author polish the diamond-in-the-rough into a finished, publishable gemstone all will be proud of. Send today for your Author's Guide and help AMSAT with its new publication strategy by contributing interesting and informative articles. And, while AMSAT cannot guarantee all materials will be published, it will make a special effort to have your manuscript accepted if you will make the effort to support your organization with an article, interesting news note, photograph or other piece. Send your materials to AMSAT, P.O. Box 27, Washington, D.C., 20044 soon. Mark your envelope clearly to indicate "Publications Materials". And watch for imminent major changes in your AMSAT publications that will, with your help, be the best they've ever been!

Incidentally, with several new publications planned and possible changes in others, AMSAT needs additional editing help too. If you have a talent in this area or believe there may be a latent one within, contact AMSAT President WA2LQQ at AMSAT HQ. Perhaps you can take a direct, important role in re-shaping the things AMSAT members read and enjoy as part of their hobby. Write today to AMSAT, P.O. Box 27, Washington, D.C., 20044.

Tracking Program Update Help Available

With the new year now aged some three months, an increasing number of satellite tracking program users are finding their "old reliable" programs do not like the 1986 Keplerian elements. This is because the older programs contained a table of Sidereal Times running through 1985. When 1986 Keplerian elements are entered, the program halts because it cannot find a 1986 Sidereal Table to refer to.

Consequently, designers of the programs including W3IWI and N5AHD are being deluged with requests for information on how to fix the programs. The programs can be easily updated by the insertion of a few lines of code. The exact nature of the change depends on which computer is being used. But in all cases, if you obtained your program from the AMSAT Software Exchange and your program requires new Sidereal Times to run in 1986 and beyond, the updates are available free of charge from AMSAT.

Simply send in a business sized SASE and be sure to tell us what computer you use, which program you are using with it and when and where you purchased it. Remember, there are often several programs which run on a given computer so you must be sure which one it is you are running. AMSAT cannot be responsible for bogus copies of Copyrighted materials or programs which have been altered.

Finally, not all programs require Sidereal Time updates. Some will run for decades without modification. So if your program is running OK on 1986 Keplerian elements, don't worry. You'll be set for the rest of the year at least.

AO-10 Operating Schedule

The following AO-10 operating schedule will be in effect mid-March.

Mode B	MA 040 to 199
Mode L	MA 200 to 216
Mode B	MA 217 to 233
Off	MA 234 to 039

On March 29 and 30, a special schedule will be in effect. On those two days only, Mode L will run from MA 200 through 233 thus extending Mode L through the second Mode B episode.

As always, it's a good idea to monitor to the beacon for advisories on schedule changes.

Short Bursts

- Dana Tremblay, WA1HUM, has been appointed New Hampshire Assistant Area Coordinator. Dana joins Paul Roemer, KG6LC, NH Area Coordinator in covering the state.
- Bob Anderson, W8KZM, has been appointed AMSAT SSTV advisor. Bob is from Saline, Michigan. He reminds users that an ad hoc SSTV calling frequency exists on AO-10 Mode B: 145.888. This may be used for SSTV and related audio experiments. SSTV users request others not engaging in SSTV to try to avoid unintentional interference with on-going experiments on or about that frequency.
- Chris ZR1L reports that a new country is active on OSCAR 10. OM Gerald VS85GA is active from Brunei.

Orbit Predictions

Monday, March 17, 1986		Satellite	MIR
MIR		Catalog number	16609
Mon Mar 17 00:37:28.996 1986 UTC:		Epoch time:	86068.93390168
Ascending node at 193.2w		Sun Mar 9 22:24:49.105 1986 UTC	
Nodal period: 91.17039 min		Element set:	37
Longitude increment:		Inclination:	51.6266 deg
23.182171 deg w/orbit		RA of node:	27.1524 deg
Element set 37, epoch:		Eccentricity:	0.0005499
Mar 9 22:24:59.105 1986 UTC		Arg of perigee:	142.8454 deg
		Mean anomaly:	217.2731 deg
		Mean motion:	15.77905815 rev/day
		Decay rate:	0.00033528 rev/day ²
		Epoch rev:	286
		Semi major axis	6715.028 km
		Anom period:	91.260200 min
		Apogee:	345.370 km
		Perigee:	337.985 km
		Ref perigee:	2989.95902760
		Sun Mar 9 23:00:59.984 1986 UTC	

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